

EXPERIMENTAL DESIGN

Defining independent and dependent variables

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Experimental Design

Defining Independent and Dependent Variables

Skill Level
Intermediate

Learner Outcomes

The learner will be able to:

- Define independent and dependent variable
- Identify dependent and independent variables in experiments
- Recognize the importance of a properly designed experiment

Educational Standard(s) Supported

6.ETS1

7.ETS2

8.ETS1

Success Indicator

Learners will be successful if they:

- List independent and dependent variables in 3 experiments
- Create a tweet that explains the importance of well-defined variables in an experiment
- Given a research question, select appropriate independent and dependent variables

Time Needed

45 Minutes

Materials List

Student Handouts, Experimental Design

Introduction to Content

This lesson introduces students to the concepts of experimental design and variables within a scientific experiment. Students have the opportunity to design a classroom experiment and identify different variables within their experiment.

Introduction to Methodology

Students begin the lesson by gaining background knowledge on independent and dependent variables from a YouTube clip. Students then work in groups to identify independent variables, dependent variables, and controls in experiments. Students share their findings with the class, and then share their knowledge in a Tweet. The lesson concludes by having students design their own experiment.

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Terms and Concepts Introduction

Independent Variable- A variable that is controlled in an experiment. An example could be the amount of sunlight or the water received by a plant. This is what is changed.

Dependent Variable- A variable that is dependent on the independent variable. This could be plant height, or amount of leaves produced. This is what is measured.

Setting the Stage and Opening Questions

Say to students: **“Have you ever thought about what goes through a scientist’s head when he or she is designed an experiment? There are multiple things to consider when designing a science experiment, and one of the most important things is the variables in an experiment. To start today, we are going to watch a video that explains the difference between independent and dependent variables.”**

Show video: <https://www.youtube.com/watch?v=0A55QRyJHPM>

Say, **“Today, we are going to learn about experimental design. By the end of class, you should be able to define independent and dependent variables, identify dependent and independent variables in experiments, and recognize the importance of a properly designed experiment.”**

Experience

Begin by breaking students into small groups and passing out the student handout, experimental design. Say to the students, **“We are going to start by working through an example as a class, and then you will work in your groups to complete three other activities.”**

Pass out the experiment information sheet to each group and allow the groups to read the description of the first experiment on the sheet. After groups have had time to read the overview of the experiment, say **“Based on the information provided, let’s work to identify the independent and dependent variables, and the controls in this experiment.”**

Lead students through a discussion to identify the variables and controls in the experiment. After all the students have correctly identified these, say to the students, **“Work in your groups to identify these components of the other two experiments on the sheet. After everyone has finished, we will share what we listed as the independent, dependent, and controls in each experiment.”**

Allow students time to work in their groups to identify the variables and controls in each experiment.

Tips for Engagement

It may be difficult for students to reach a consensus. If this is the case, step in and serve as a mediator and help the group reach a decision.

Share

After all groups have finished identifying the variables and controls in each experiment, have them share what they identified as the independent variables, dependent variables, and controls for each of the experiments.

Process

As students share their responses, ask probing questions to encourage students to think about why they identified variables the way they did. Correct any mistakes that the students have made.

*For this lesson, the Share and Process sections happen concurrently.

Generalize

Ask students to craft a Tweet that explains the importance of a well-designed experiment to share with the class. A Tweet is composed of 140 characters, including spaces.

Ask students share their completed tweets with the class.

Apply

Say to the students, **“Now that you have a firm grasp on what independent and dependent variables are, you are going to design your own experiment. Let’s assume you need to study the effect light has on plant growth. Using that statement, work in your groups to come up with independent variables, dependent variables, and controls for an experiment to address this research topic.”**

Allow students to work and then have them share their thoughts with the class.

Life Skill(s) from TIPP(s) for 4-H

6th Grade

Identify the parts, steps, and necessary sequence or order to achieve a goal. (Head Managing)

7th Grade

Consider the total situation when viewing a project. (Head Managing)

8th Grade

Plan a strategy for a given problem or situation; set a goal and determine ways to reach it. (Head Thinking)

Supplemental Information

Educational Standards Met

6.ETS1: 1) Evaluate design constraints on solutions for maintaining ecosystems and biodiversity. 2) Design and test different solutions that impact energy transfer.

7.ETS2: Examine a problem from the medical field pertaining to biomaterials and design a solution taking into consideration the criteria, constraints, and relevant scientific principles of the problem that may limit possible solutions.

8.ETS1:1) Develop a model to generate data for ongoing testing and modification of an electromagnet, a generator, and a motor such that an optimal design can be achieved. 2) Research and communicate information to describe how data from technologies (telescopes, spectrometers, satellites, and space probes) provide information about objects in the solar system and universe.



EXPERIMENT 1

INDEPENDENT

VARIABLE(S): _____

DEPENDENT

VARIABLE(S): _____

CONTROL(S):

EXPERIMENT 2

INDEPENDENT

VARIABLE(S): _____

DEPENDENT

VARIABLE(S): _____

CONTROL(S):

EXPERIMENT 3

INDEPENDENT

VARIABLE(S): _____

DEPENDENT

VARIABLE(S): _____

CONTROL(S):

TWEET

Studying the impact of light on plant growth

INDEPENDENT

VARIABLE(S): _____

DEPENDENT

VARIABLE(S): _____

CONTROL(S):

Print two copies, cut apart and laminate for continued use.

Experiment 1

Johnny is studying the impact of water temperature on dissolving salt. He sets up an experiment that has several different temperatures of water. He pours salt into the container and measures the time it takes for the salt to dissolve while he stirs.

Experiment 2

Monique wants to learn more about surfaces where bacteria are likely to grow. She sets up an experiment that has different types of surfaces (slick, rough, sticky, wet) and touches each surface evenly to inoculate the surface with the bacteria present on her hands. She lets the area sit for 2 days and then inoculates petri plates from each of the surfaces to observe the bacterial growth.

Experiment 3

Maggie wants to learn more about the best way to keep her family's bread from molding. To do this, she sets up an experiment by placing slices of bread in different locations around her house in a plastic ziplock bag. She leaves the bread alone and takes observations at different intervals throughout the week. After the weekends, she compiles her results and determines the best way to store her family's bread.

Teacher Handout

SOLUTIONS

Experiment 1: Independent Variable - Water Temperature

Dependent Variable - Time to dissolve

Controls - Amount of Salt, Stirring pattern

Experiment 2: Independent Variable - Surface type

Dependent variable - Bacteria growth on the petri plate

Control - Bacteria inoculated on the surfaces

Experiment 3: Independent Variable - Location for storing bread

Dependent Variable - Results on bread (stale, mold growing, etc.)

Control - Bread type and environment inside the ziplock bag